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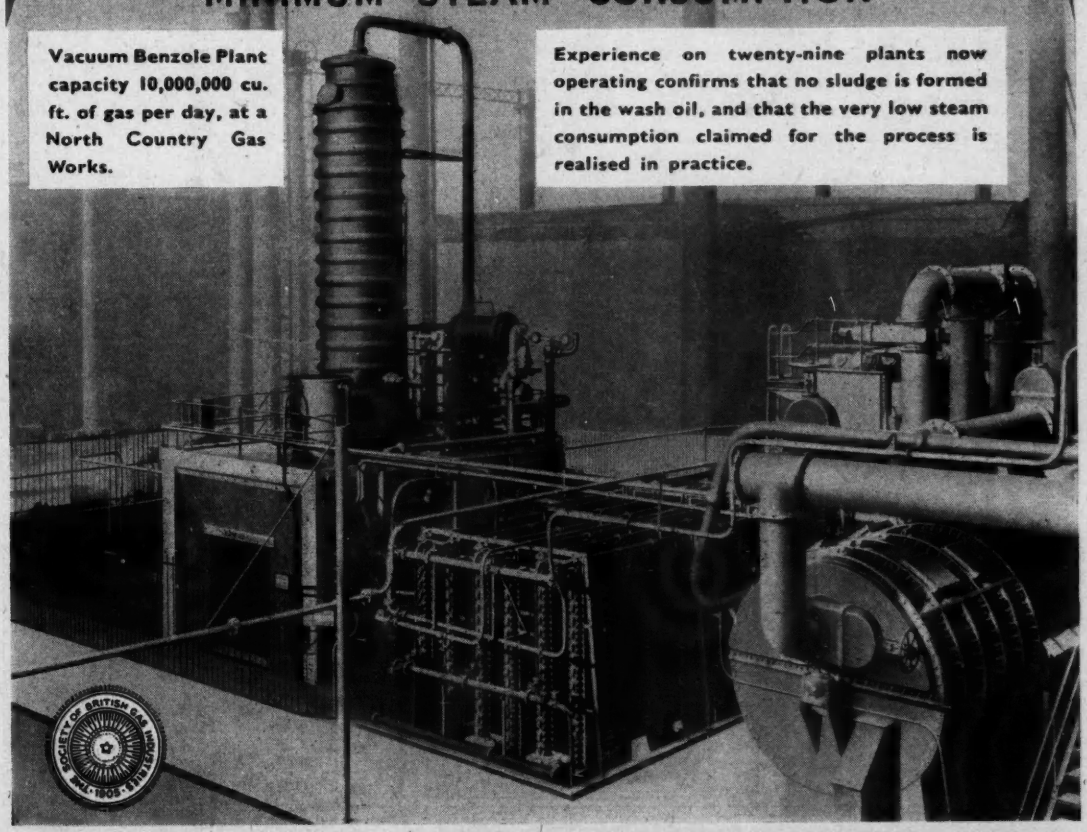

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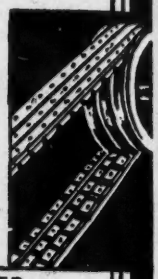

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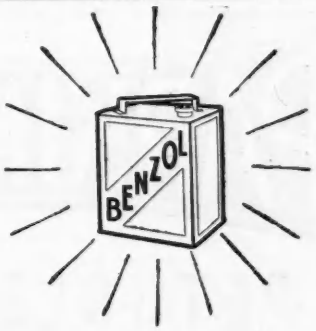

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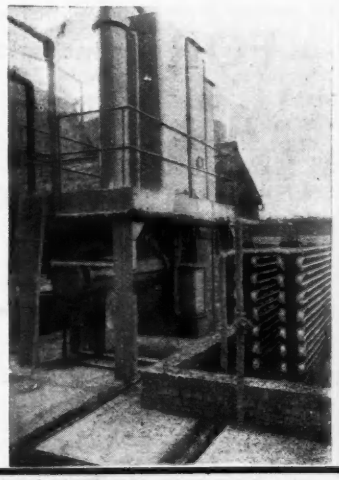

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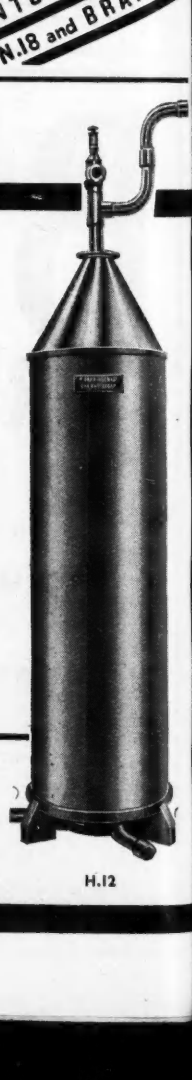

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GAS JOURNAL, AUG. 18, 1943
VOL. 242 95th YEAR No. 4187

EDITORIAL NOTES

ACHIEVEMENT

IN the years prior to the war we published a good deal of information on the work of Mr. Ralph Halkett in linking up the coking plants in South Yorkshire and utilizing their surplus gas for town supply—a policy actually adopted as long ago as 1931. At the present juncture, amid all the discussion on planning, integration of gas supply, utilization of coke oven gas, and so on, we take particular pleasure in that in our issue to-day we are able to tell a story of achievement of later date. It is a straightforward account, for obvious reasons necessarily circumscribed, of the West Yorkshire Gas Grid, which, through the courtesy of the United Kingdom Gas Corporation, we have been able to inspect very thoroughly. Our visit proved to us most encouraging and stimulating, full of interest from aspects of modern engineering, administration and policy, and gas service both domestic and industrial. Naturally we wish circumstances were such that we could explain more fully this practical scheme, which is operating smoothly and with great satisfaction; however, we think that what we record will amplify and substantiate our belief in its possibilities. The scheme is a bold and imaginative one, and its success to date well exemplifies what can be done, in the face of difficulties, by courageous private enterprise employing modern methods towards the goal of service to the community coupled with the rational use of coal. The results undoubtedly justify the faith of the originators of the scheme, and stand firm witnesses to careful planning and sound execution.

The West Yorkshire Gas Grid, a system of integration, has made available over a wide and fertile area an ample and economic supply of gas of constant quality and low in sulphur. The high-pressure mains traverse both highly industrialized and rural districts; industrial processes of great variety are being fed with heat on tap, the while the villager is enjoying a type of gas service hitherto unknown to him. Coke oven gas which would otherwise have been wasted has been most effectively harnessed, and in this regard the scheme is a pointer to what may well lie ahead through greater co-operation between the gas and the coke oven industries. The scheme is an outstanding example of cohesion in gas supply brought about without loss of individuality; its potentialities are very heartening. We look to the time when such coke ovens as are unallied to steel works will be regarded as a source of town gas supply and be designed and operated accordingly. Numerous coke oven plants operating to-day are really wasteful old crocks; it is to be hoped that after the war these crumbling monuments will be replaced by plants built for the dual function of gas and coke supply and operated to this end by skilled technicians. The field is there; it is in the national interest that it should be developed.

Though necessarily couched in somewhat general terms, our article does, we hope, point to the fundamental principles which have been observed in making the West Yorkshire Gas Grid a practical and economic proposition—covering 80 miles of high pressure mains connecting at the moment seventeen gas-works to coke oven gas supply. We emphasize, for example, the importance of maintaining in the grid mains an hourly load factor of 100%, to which end each works fed from the grid must take its daily requirements evenly over the 24 hours. It must be so arranged that the district low-pressure holders balance the steady input with the fluctuating district demand; the essential point of difference between the operation of the grid and a normal high-pressure system is that the constant conditions to be maintained are those of volume, not of pressure. On this largely depend the economics of the system. Generally all gas-works taking a bulk supply are dismantled. There are, however, key works which provide standby capacity, maintaining their plant in first-class condition for emergency operation. Actually there is standby capacity up to the maximum input of the largest single coke oven unit; there appears ample safeguard against untoward contingencies. The functions, responsibilities, and obligations of the Distributing Company are sharply defined. The undertakings supplied also have their individual responsibilities. That is why we have linked with our grid story some idea of how these constituent undertakings of the United Kingdom Gas Corporation are, through organization, having—to use a mixed metaphor—their feet firmly placed to shoulder these responsibilities.

We have headed this note "achievement." It seems to us that the benefits gained by the undertakings taking supplies of low-sulphur, constant-quality gas from the grid demonstrate clearly the inherent soundness of the composite scheme's conception. The scheme is flexible; it is adaptable. It has enabled the undertakings connected to take care satisfactorily of gas loads in the national interest which obviously in the ordinary way they could not have approached without considerable extensions to plant and increase of staff. It is a fact that since the advent of the grid gas in 1940 the output of gas by these undertakings for essential purposes has shown a tremendous expansion; and we would add that with one or two exceptions none of this development can be considered as purely wartime load. Wholly encouraging and most invigorating.

TO-MORROW'S CONSUMERS

MEMBERS of the Youth Clubs of to-day will be the housewives and householders of the immediate post-war future, and it is therefore a very sensible move on the part of the Gas Industry to co-operate with the Youth Movement and thus bespeak the interest of those who will be the people to say what kind of houses they want built and what equipment they need; who must be educated to appreciate the importance of the Gas Industry to the nation and the advantages of gas as a labour-saving fuel in home and factory. The British Commercial Gas Association has set up a special committee to deal with this aspect of public relations and to assist members to make contact with and support their local Youth Clubs, and its first report indicates that a good start has been made, both at headquarters and in many different parts of the country. Thousands of copies of the "Handywoman's Course" booklet prepared in co-operation with the Women's Gas Council have gone to branches of the Girls' Training Corps; instructional recreation has been offered through County Education Authorities to Youth Clubs under their care; the B.C.G.A. film library has been offered on loan for Youth Club entertainments; and some of the popular literature of the Association is being brought up to date. Several education authorities have responded favourably to the Association's offer, and many gas undertakings which have maintained contact with their local education authorities for many years have found it easy to discuss with the local youth organizers the plans being made for the Youth Clubs in their districts.

Reports from undertakings up and down the country show how the job has been tackled from a variety of angles. In several districts the "Handywoman's Course" has been the basis for lectures and practical demonstrations. In one town the girls clamoured to visit the gas-works after hearing the lecture; in another they asked for a further course of lectures;

and everywhere the young people declared that they had previously had no idea that gas was so interesting. Films and practical demonstrations have been arranged in several towns. At Leamington the Girls' Training Corps had a written examination after their "Handywoman's Course" lectures, set and corrected by a member of the showroom staff. There was also a practical test in adjusting lighting burners, putting on gas mantles, removing, cleaning, and refixing burner globes, cleaning the cooker, turning off the gas at the meter, dealing with an escape of gas, cleaning a gas iron, and identifying various parts of gas appliances. With the approach of autumn requests from Youth Clubs for help are likely to increase, and all the District Chairmen of the B.C.G.A. have been asked to try to arrange meetings of sales managers and others on the staffs of gas undertakings to discuss ways and means by which assistance can be given.

Regionalization

As a contribution to the general pool of ideas for the future organization of the Gas Industry, we reviewed in a series of articles published in the "JOURNAL" about a year ago some of the regionalization problems of the kindred public services. Early in the series we dealt with water supply, and noted that "on the question of the ideal area for regional administration the feeling in the Industry is that, as planning will require not only a central planning authority, but also regional or district planning authorities, the district planning areas should conform to watershed areas, and should not be restricted by boundaries of local government areas, since proper planning in what is really an economic sphere should be based on natural and not on artificial areas." Important recommendations along these lines—and they have a bearing on the question of river pollution—have now been made in the Third Report of the Central Advisory Water Committee, presided over by Lord Milne. The report is concerned with river boards, which have various functions such as land drainage, fisheries, transport, and navigation, as well as public water supply, but as three-quarters of the population of England and Wales is supplied with water obtained from rivers, streams, and springs, it has a direct bearing on the subject of our review. The report states that "there is ample evidence that the existing system of river control is generally inadequate and sometimes wasteful." There are more than 1,600 local authorities, including joint committees, fishery boards, and some water undertakers, with statutory powers for the prevention of river pollution, and many of them are too small to be able to provide the full time services of scientific and technical staffs. The committee recommends the establishment of 29 new river boards to supersede the existing authorities, and to be responsible for all questions of drainage, water conservation, pollution, land irrigation, navigation, and fishing. It is recommended that the administrative area of the new boards, which would take over the duties now carried out by catchment and fishery boards and other authorities, should be the watershed areas in the case of the larger rivers, and that for smaller rivers two or more watersheds should be grouped under one board. No change is recommended in the case of the Thames and the Lee, where the present arrangements are satisfactory, and it is unlikely that much economy or improved efficiency would result from an amalgamation.

Personal

Mr. WILLIAM C. CAMPBELL, Gas Engineer and Manager, Galashiels, who, as announced in the "JOURNAL," was appointed to a similar position at Dunfermline, has written to Dunfermline Town Council stating that circumstances have arisen which prevent his accepting the appointment.

* * *

Mr. GEORGE DAVIES, Sales and Distribution Superintendent to the Perth Corporation Gas Department, has been appointed to a similar post with the Great Grimsby Gas Company. Trained at Barnoldswick, he was Distribution and Works Superintendent to the Coalville Gas Department, Leicestershire, before going to Perth in 1937.

* * *

Aberfeldy Gas Light Company has appointed Mr. W. W. WALKER, the Town Clerk, as Secretary to the Company in succession to the late Mr. John Ferguson, J.P.

* * *

Mr. W. R. OLIVER, well known for his display work at the B.C.G.A. before the war, has been appointed Inspector of M.O.I. posts Middle East, and has left London for Cairo to join the staff of Mr. Curteis M. Ryan, Controller Middle East. He has been released for this purpose by the B.B.C., for whom he had been Public Relations Officer in Northern Ireland since January.

* * *

After serving for 60 years with the Bathgate Gas Company, Ltd., 47 of which as its Manager, Mr. JOHN B. ROBERTSON has informed the Company of his intention to retire. His long connexion with the Company is the more interesting in that his father held similar office before him.

* * *

Mr. C. S. KNOWLES, Manager of the Hatfield Branch of the Watford and St. Albans Gas Company, was married at Hatfield (Herts) Parish Church on Saturday to Miss Maud Morgan.

* * *

The completion of half a century of service with the firm has just been celebrated by Mr. W. F. HARDSTONE, a Director of Messrs. G. A. Harvey & Co. (London), Ltd. Mr. Hardstone is head of the Metal Perforating Department.

National Gas Council

A Meeting of the Central Executive Board of the National Gas Council was held on Aug. 10 at Gas Industry House. The Chair was taken by Mr. Frank H. Jones (Vice-Chairman).

Before proceedings commenced, Mr. Evans was congratulated by the Board upon having had the Honorary Degree of Doctor of Science conferred upon him by the University of Leeds.

A report on the general coal position was received, and a resolution was passed deploring the inadequate supplies of suitable coal which are being delivered to gas undertakings. It was reported that the Coal Committee of the Conjoint Conference would meet at an early date, and the views of the Board on certain matters were obtained for submission to that Committee.

Dr. Evans, Chairman of the Gas Advisory Committee to the Ministry of Fuel and Power, made a report to the Board with regard to the proceedings of the Committee.

It was agreed that a small committee of not more than three, consisting of representatives of the National Gas Council and the British Commercial Gas Association, be set up in each district to deal with the position of housing of working classes—post-war programme.

The Board expressed appreciation of the immense amount of work undertaken by the Technical Sub-Committee of the National Gas and Electricity Committee in obtaining evidence as to the success of the voluntary fuel economy campaign, and the results of their investigation were reported to date.

It was stated that the Water Undertakings Bill had concluded all its stages in the House of Lords, and would be introduced into the House of Commons after the Recess. There was only one point which it was thought required further consideration by the Industry, and that was remitted to the Pollution Committee of the Institution of Gas Engineers.

The next meeting of the Board will take place on Sept. 14.

Association of Gas Corporations

We have received a copy of the Constitution and Rules and Lists of Members of the Association of Gas Corporations, which (as the Association of Gas Holding Companies) was founded on July 13, 1937.

The principal Objects of the Association are (i) to guide and assist and encourage the closest co-operation and co-ordination among Gas Corporations so that their Associated Companies shall provide the best service to the community, and (ii) to collaborate with the National Gas Organizations in the planning and operations of the Gas Industry.

The Member Corporations—which control 250 Gas Undertakings, representing an embarked capital of £25,000,000 and the supply of 41,000 million cu.ft. of gas per annum to 1,400,000 consumers—and Council of the Association are as follows:

President.—Sir David Milne-Watson, Bart., LL.D., D.L.

Member Corporations and Council.—Associated Gas and Water Undertakings, Ltd., W. H. Bennett, J. R. W. Alexander, M.A., LL.B.; Associated Utilities Ltd., A. V. Barraclough; British Gas Light Company, Ltd., Henry Woodall, J.P., A. J. Mumford; Caledonian Gas Corporation, Ltd., Duncan Campbell, M.A.; Gas Consolidation, Ltd., R. S. Snelling; General Gas and Electricity Company, Ltd., F. S. Nicoll; Severn Valley Gas Corporation, Ltd., Major Julian Day, M.C., G. M. Gill; South-Eastern Gas Corporation, Ltd., Sir David Milne-Watson, Thomas Hardie, K. W. Hickman, H. A. Probin; South Midland Gas Corporation, Ltd., W. E. Caton; South-Western Gas and Water Corporation, Ltd., C. Holmes Hunt, M.A.; United Kingdom Gas Corporation, Ltd., R. B. H. Ottley, M. H. Tetley, Vice-Admiral A. L. Snagge, C.B., Colonel W. Moncrieff Carr, O.B.E., T.D.

Honorary Secretary.—J. R. W. Alexander.

Communications should be addressed to the Hon. Secretary at the Offices of the Association at 2, Chart Lane, Reigate (Telephone: Reigate 2468. Telegrams: Sagacity, Reigate).

Planning and Reconstruction

A year ago the *Planning and Reconstruction Year Book* (Todd Publishing Co.) was a newcomer among the annual reviews. Since the first issue its subject has acquired a new status with the setting up of the Ministry of Town and Country Planning, with Mr. W. S. Morrison as its head, and the 1943 edition reflects the growing interest in post-war planning and the large number of people now engaged in it. It takes 42 pages to cover the central and regional personnel of the Ministry and its committees, and there are five pages of planning organizations, 16 pages of books, periodicals, and films, 4 pages of regional planning authorities, and 12 pages of "Who's Who in Planning." Prominent among 14 technical articles are one by Dr. E. V. Evans, who, when he wrote it, was President of The Institution of Gas Engineers, on "The Gas Industry in Post-War Britain," and one by Dr. G. E. Foxwell on "The Provision of Smokeless Fuel for Post-War Reconstruction." Dr. Foxwell closes with the suggestion that one authority divided into regional boards should control the production and distribution of smokeless fuel, based on a production section, a gas distribution and utilization section, and a coke distribution and utilization section. An extension of such a scheme would be (*a*) unified research co-ordinated by a central organization for the whole Industry based on production, gas utilization, and coke utilization, and (*b*) an extension jointly by the collieries and the Gas Industry of the chemical processing of coal (*e.g.*, the Fischer-Tropsch process) and of the by-products of carbonization together with an extension of the chemical manufacturing side of the industries. The new organization would thus, he says, become a Coal Processing Industry in a very real sense.

Saving Solder

In a recent Address the Vice-President of the American Gas Association, Mr. E. R. Acker, referred to the use of recovered solder. Several companies, he said, have recently conducted tests based on the belief that it has been the general practice of the Gas Industry for years to use more solder than was actually required for the adequate repair of gas meters. In the case of his own company, they had demonstrated to their satisfaction that all classes of meter can be repaired without the use of any more solder than that recovered during the repair operation. Their experience with 500 meters repaired to date by the new method showed an average saving of 30% of the recovered solder. Even in the case of new meters coming in for repair for the first time, they had demonstrated that the meter could be completely re-sealed with the solder recovered during the operation, and that a small amount would, in fact, remain unused. In one test they actually opened and re-sealed one meter three times in succession, and each time had a small amount of solder left unused.

The method used in removing the old solder and applying the new requires a somewhat new technique in handling the soldering irons, but can be readily mastered by the meter shop personnel with careful supervision and within a reasonable period of time. It involves the use of a sweated joint in place of the usual beaded joint. Meters re-soldered by this method have been subjected in every case to a 2½ lb. pressure test without failure of a single joint, and in several tests cases have been subjected to internal pressures up to 20 lb. without failure of a joint before buckling of the case.

Fire Extinguishing Device

We have been supplied with a description by Mr. A. G. R. Kennett, District Superintendent to the Isle of Thanet Gas Light & Coke Company, of an extinguishing device for fires in gas services up to and including 2 in. internal diameter. The device consists of a sheet metal cylinder, 4 in. in diameter, 6 in. long, one end closed. A swivel joint and lock nut fixed to a band which encircles the cylinder enables the user to place himself in any convenient position and distance from the fire by screwing the device to a length of ordinary ⅜ in. gas tubing.

In the case of a fire on a service pipe which is exposed, the cylinder (half filled with wet clay) can be used in the hand. By quickly placing the device over the end of the pipe, it acts in the same way as the old-fashioned candle snuffer. Experience has shown that service pipes may be fractured and ignited in cellars, basements, and under fallen timber. Fire fighting is then made difficult and the fire likely to spread. This situation can be overcome by the use of the device attached to a length of tubing, as it can be worked through the debris to the seat of the fire, and so prevent a serious conflagration.

It is a useful addition to the kit of gas repair squads, and owing to ts simplicity, could be used by members of the Civil Defence and N.F.S.

The device could be made up, by any undertaking, from short ends of 4 in. galvanized flue pipe, a suitable length of 1 in. by ½ in. strap iron, ⅜ in. nipple, B.S.P. thread, ⅜ in. elbow, B.S.P. thread, and a ⅜ in. winged back nut, B.S.P. thread. First make cap and close one end of 6 in. length of flue pipe. With the strap iron make a band to fit outside of cylinder, and weld to secure, weld ⅜ in. long thread nipple to the band, screw on winged back nut and elbow, and paint to prevent rusting.

§§

Scarcity of Matches has given scope to enterprise in the production of flint lighters. The FlinTop Distributing Co., Ltd., 1, Roman Way, London, N. 7, inform us that despite the big demand they can give practically immediate delivery of both their "FlintoR" gas lighters and their two types of pocket lighters, with unusually generous size of flint, which ensures long life. Members of the B.C.G.A. will have heard that the Association is arranging for bulk supplies of the gas lighters, for which early orders are invited from members.

Discussion took place at Macclesfield Town Council on a proposal (which was approved) to extend the restricted street lighting by the installation of fittings for lighting 50 additional gas lamps at a cost of £225. One councillor contended that as the Corporation had gas and electricity undertakings there should be a greater measure of co-ordination in regard to street lighting. Ald. T. M. Abraham, Chairman of the Lighting Committee, said the committee came to the conclusion that the only way to light the streets at present was by gas.

Oldham Gas-Works Committee has adopted a resolution stating that it could not agree to any scheme of nationalization that injured or impaired the ownership of gas undertakings by local undertakings. This motion was approved after the defeat of an amendment which suggested the formation of joint gas boards constituting the amalgamation of municipally owned undertakings, retaining direct control by representation. At the Town Council meeting Councillor Bonney said the Council should retain the present position in regard to the gas-works until they were compelled to accept a scheme of nationalization or express opinions in favour of regionalization. The Gas Industry needed a central authority.

An Item has been added to the range of British Standards for Steel Air Receivers in the form of the newly published British Standard for valves, gauges, and other safety fittings. This specification provides for fittings for air receivers and for compressed air installations for maximum permissible working pressures not exceeding 1,000 lb. per sq. in., but does not deal with valves for portable gas cylinders. A section dealing with installation requirements is included which requires that each receiver shall be protected by a suitable safety valve and a pressure gauge. The construction of the materials used is dealt with in detail and a section is incorporated covering testing and inspection. Copies of this new British Standard (No. 1123; 1943) may be obtained from the British Standards Institution, 28, Victoria Street, S.W. 1, price 2s. 3d. post free.

A Further Contribution to the development of stronger tin-base alloys suitable for use as bearing metals is reported in a paper by Dr. W. T. Pell-Walpole, in the *Journal of the Institute of Metals* for June. The tensile properties of a series of tin-antimony-cadmium alloys were examined after quenching and prolonged tempering treatments. It has already been shown (*Journal of the Institute of Metals*, October, 1942) that the hardness of tin-base alloys in the range antimony 9 to 10%, cadmium 1 to 1½%, balance tin, can be appreciably improved by heat treatment. It is now shown that the same range of alloys has improved tensile strength after quenching from the highest practicable annealing temperature followed by prolonged tempering at 140°C. The best alloy from this point of view contains 9% antimony, 1½% cadmium, balance tin. The tensile strength of the alloy reaches 6 tons per sq.in. as quenched and tempered, and this strength is retained at 140°C. This temperature was chosen as being near the maximum at which tin-base bearings may have to operate continuously. Reprints of Dr. Pell-Walpole's Paper (Publication 114A) may be obtained on request to the Tin Research Institute, Fraser Road, Greenford, Middlesex.

Dividends

The Croydon Gas Company has declared dividends for the half-year ended June 30 at the following rates per centum per annum, less income tax: Preference Stock, 4; Maximum Dividend Stock, 5; Sliding Scale Stock, 6.

The Directors' Report of the Montrose Gas Company, Ltd., showed, after deducting depreciations, a profit of £4,575, which, with credit of £2,753 from last year, left £7,328 available for distribution. From this, an interim dividend of 4¼% was paid in January, absorbing £2,125, leaving £5,203. From this £500 was carried to contingency fund, and final dividend of 4¼%, less income tax, was declared, leaving a balance of £2,578, subject to Directors' remuneration.

Lochgelly Gas Company, Ltd., Fife, reports gross profits of £6,396 and net profit of £592. The sum of £5,649 was paid for income tax and excess profits tax. Dividend of 4%, less tax, is being paid and £395 is carried over.

Diary

Aug. 26.—Association of Gas Corporations: Council, Gas Industry House, 2.30 p.m.

Sept. 24.—Joint Research Committee, Leeds University, 10 a.m.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

THE WEST YORKSHIRE GAS GRID

A MODERN SCHEME OF GREAT POSSIBILITIES

WE have just returned from an extended tour of the West Yorkshire Gas Grid, and we may say at once that the experience has been stimulating and entirely encouraging. New methods, new technique, new gas service developed and brought about by private enterprise during a period of unexampled difficulty, resulting in cohesion without loss of individuality, and making possible a plentiful and cheap supply of gas of constant quality which has helped and is helping enormously the war effort and which, we feel sure, will post-war consolidate gas over a wide area, both urban and rural, much of it highly industrialized, compact, and unquestionably full of possibilities. It must be appreciated that our account of the impressions we gained is, for obvious reasons, circumscribed ; but we can assure our readers that when peace returns we shall be able to relate a remarkable story of integrated gas supply largely based on pithead to consumer service.

In point of fact, since the war we have published a considerable amount of information on this ambitious scheme, which, planned with confidence and vision, is bound up with the working of the United Kingdom Gas Corporation, Ltd., of which the undertaking operating the grid—the West Yorkshire Gas Distribution Company—is a subsidiary. And we give here these "JOURNAL" references which could to advantage be consulted in conjunction with our present notes on the practical operation of the scheme: Vol. 230, p. 141 ; Vol. 238, pp. 175, 210, 252, 287.

Bold and Imaginative Conception

The West Yorkshire Gas Distribution Company, it may be recalled, was planned and conceived by Colonel W. M. Carr, Managing Director of the United Kingdom Gas Corporation, to co-ordinate existing and potential gas supplies within the area of supply of a group of geographically related gas undertakings in West Yorkshire. It was a pioneer—the first statutory company to be incorporated as such, deriving its powers from an Act of 1938. It was realized at the time that a number of coke oven plants operating in West Yorkshire were producing gas which could be made available for town purposes and that the output could be increased; it was realized, too, that plant existing at certain gas-works was capable of more gas than represented by its output at the time. The aim was, through co-ordination of gas supplies, to eliminate to general advantage uneconomic or redundant gas manufacturing units, the while rendering available abundant supplies of gas of excellent quality at economic rates. Owing to opposition the area of supply sought was restricted to the 1938 limits of supply of the undertakings controlled by the United Kingdom Gas Corporation. However, the advantages which have in fact accrued to those undertakings connected by now to the Distribution Company's mains have been such that opposition is dwindling away, and undertakings other than those controlled by the Corporation are taking large volumes of gas from the grid mains of the Distribution Company. But for the war, development would have been more rapid.

The Proof of the Pudding . . .

In spite of the war, the system is now extensive, embracing both industrial and rural areas; the mains are of a size sufficient to serve as the nucleus of a future regional grid. The mains carry gas at a maximum pressure of 35 lb. per sq. in.; only purified gas is distributed. Already over a large area of supply standardization of calorific value (500 B.Th.U. per cu.ft.) has been achieved and the gas is of constant quality; efficient drying of the gas is attained through compression with after-cooling. At one of the coke ovens, extraction of sulphur compounds by oil washing under pressure (30 lb. per sq. in.) gives a gas containing less than 5 grains of sulphur per 100 cu.ft. We have inspected this plant with the greatest of interest, and we wish we could say a great deal more about it. In design, it has been specially adapted to the production of town gas; it incorporates all the equipment necessary to that end. The ovens can be fired either by coal gas or producer gas generated in external plant. At present the capacity of the gas producers is sufficient for firing half the ovens. If needs be, the whole of the gas made by these ovens can be made available to the grid without increasing the manufacture of coke. The gas is purified at the works, the purifiers and by-product plant being rated for a throughput of 8½ million cu.ft. a day, and throughout the plant is equipped with control and regulating devices to ensure uniformity in the quality of the gas.

There are other sources of coke oven gas supply for feeding into the grid. At one works the plant is obsolescent; but when circumstances permit, the plant will be completely reconstructed on the lines of the plant previously described, and in the meantime a start has been made by the installation of modern purifying, compressing, and exhausting plant and by the provision of the necessary subsidiary equipment for metering and controlling the supplies to the grid. The new apparatus is designed for a daily throughput of 5 million cu.ft.; it is intended to reconstruct the plant to this capacity as a minimum. A scheme of a similar nature has been planned for another source of supply. The surplus gas from a coke oven plant is at the moment being entirely absorbed locally, and no supplies are available for compression into the grid system. Provision, however, exists for taking any surplus gas which may become available. In addition the scheme is designed to permit of supplies being taken from the most efficient gas works two of which are maintained.

At present 10 million cu.ft. of coke oven gas per diem, conforming to a rigid specification, is available for the grid—*but this is only a start.*

But we seem to be getting along too quickly. The scheme is working smoothly now. We are sure that, in the light of experience, the potentialities are immense. There is provision for continuity of the coke markets in the areas of the gas undertakings taking grid supplies of gas; sufficient tonnage of coke is placed at the disposal of the undertakings to enable them to retain and develop coke sales in their own areas. However, let us for a moment look back to the early days of development—days not by any means far distant.

Confidence and Vision

As a beginning there was a survey to estimate likely future loads. A survey of twelve undertakings which made, in 1936, 850 million cu.ft. showed a conservative potential industrial demand of 3,650 million cu.ft. Main sizes were calculated to handle 5,350 million cu.ft. per annum, representing a potential expansion of more than 600%. Experience has shown that there was nothing fantastic about this idea, which would, we suggest, have staggered any small, medium, and even large undertaking operating solo. Actually, in a number of undertakings covered by the West Yorkshire scheme there have been increases of 100% a year. It is not at all beside the point to visualize manufacturing works planned on the broad scale, planned in units of 5 or 10 million cu.ft. per day capacity. With a regional grid surplus plant capacity could be reduced to a minimum, an area for the moment short of gas taking part supplies from an area having surplus plant. It is all a question of balance—about which more anon.

The Position To-day

We turn to the position to-day. The West Yorkshire Gas Distribution Company now operates nearly 80 miles of main ranging from 4 in. to 18 in., and connecting 17 gas-works to the coke ovens. In addition there is a large mileage of high-pressure mains fed with gas at pressure from the grid, but operated by the various undertakings. The mains are of spun iron with Stanton-Wilson joints, except for one section of five miles of 8-in. main, which is of steel with welded spherical joints. All mains were tested with air at 60 lb. per sq.in. pressure, no fall in pressure being allowed over a period of 24 hours. The gas lost in transit averages 1.5% only, the initial pressure being 35 lb. per sq.in. Valves in pits are provided at approximately one mile intervals, and at all branches. High pressure syphons with test pressure points and A.R.P. standpipes, in addition to the usual dip pipes, are provided at all low points. Where the main is above ground, or where there is less than 3 ft. of cover, steel pipes are employed. All the mains were laid by contract to a detailed specification enforced by a supervisory staff; and we may mention that the initial 50 miles was laid in six months.

This bald statement is easy enough to set down on paper. Planning and execution of the work were not quite so simple, as this short outline will indicate. The route of the various sections of main which had been agreed with the local authorities was drawn on 25-in. Ordnance sheets. The sheets were cut down to strips and the strips for a whole section were reproduced as radiographs twice the size—*i.e.*, to a scale of 50 in. to 1 mile. Prints for each section were then joined into a continuous strip, and the surveyed route of the main, showing bends, junctions, tees, and hatch boxes was plotted with copious notes. Where wayleaves through private property had been negotiated, essential information was given regarding tenants and owners, and any special precautions to be taken during the progress of the work. This provided a working drawing, but the route of the main shown on the strip maps was subject to deviation due to unforeseen obstructions revealed by trial holes. A chain survey of each section was made as mainlaying progressed, and details were recorded of the cover, nature of subsoil, unforeseen obstructions, crossing of other public utility services, and so on. And these details have been recorded on a further set of strip maps, with large scale drawings at points of special complexity, providing a complete and accurate record. This we refer to as indicative of the thoroughness with which the work was undertaken as a whole, as we were able to appreciate for ourselves as we went almost foot by foot along the entire route of the mains system.

We were able to appreciate, too, that mains laid away from the roads across country through private land are peculiarly suited to bulk gas supplies. The Distribution Company has no statutory powers to this end and can only proceed by wayleave. Despite the

lengthy negotiations entailed, however, 20% of the first 60 miles of main to be laid was under wayleave agreement, and in later sections now surveyed this is increased to over 50%. Experience gained points to the necessity for similar powers to be made available to gas undertakings for the compulsory acquisition of wayleaves, subject, of course, to appropriate safeguards, as are now enjoyed by electricity undertakings, if gas grids are to be extensively developed in the future.

Responsibilities Defined

The Distribution Company is responsible for the design, construction, and maintenance of all plant up to the inlet of the station meter. The undertaking being supplied has to provide and maintain a meter of a type and in a condition suitable to the Company. To meet the conditions of constant hourly "take"—a most important factor to which we shall refer later—special volumetric governors have been developed, these maintaining a predetermined rate of flow irrespective of inlet or outlet pressure conditions. The orifice plate incorporated in the governor serves also to impulse a flow meter which indicates and records the rate of take.

A number of undertakings have their own high-pressure systems, previously fed from boosters or compressors. A modified form of volumetric governor has been developed to enable the grid pressure to replace the local compressors, while retaining, it should be emphasized, the constant rate of take from the grid. Hence the undertakings concerned have automatically been relieved of their cost of compression —representing considerable economy.

And what a neat engineering job the Distribution Company has made of the "governor stations." Impressive in an urban district, they are equally, if not more, impressive in a rural area, where the "gas-works" could, to propaganda advantage at any rate, be housed in a glass case along the high road or main street, a silent witness to what lies beyond modern gas service. No, we are not romancing, though we will return at once to the severely technical.

Daily and Hourly Load Factor

We examine the load factor. Before the grid supply came into being the 14 gas-works now given a *total* supply had daily load factors varying from 61% to 79%, and averaging 68%. When these were supplied from the grid the incidence of additional industrial loads raised the average to 74%, while the diversity factor enabled these loads to be met with a grid daily load factor of 80%, equivalent to 292 maximum days per year.

Much has thus been done to increase the daily load factor upon the gas-producing plants. However, further improvements are possible. For example a large undertaking adjoining the grid and manufacturing gas has a pronounced high daily peak on Sundays, when the grid has a low peak due to the incidence of the industrial demand. A partial supply to the undertaking each Sunday would be of mutual advantage.

It seems to us clear that the greater the diversity factor—*i.e.*, the greater the number of undertakings supplied—the higher will be the daily load factor. There is the further important advantage in that trade slumps, which may prove serious to a specialized town's undertaking, will have much less effect when buffered by the diversity factor of a grid supply.

From what we have said, it follows that it is of the greatest importance that the hourly load factor be maintained at 100%. To this end each works taking gas from the grid must take its daily requirements from the grid evenly over the 24 hours, the volumetric governors automatically ensuring this and the holders balancing the steady input with the fluctuating district demand. In practice, no difficulty is experienced in bringing this about—*provided adequate storage capacity is maintained at each station.*

The Method of Control

The essential point of difference between the operation of this type of grid and a normal high-pressure system is that the constant conditions to be maintained are those of volume and not of pressure. The method of control thus depends on all compressor attendants maintaining the agreed rate of input and the station attendants the agreed rate of take, irrespective of the pressures in the grid. Any departure from these rates must be approved by Control, who makes the necessary compensations. The pressure at any point is determined by Control, who increases the take or decreases the input if pressures are rising too high. Here we would mention the storage capacity of the grid, a matter at the moment of about 1 million cu.ft., which provides for the necessary time lag in which to make adjustments.

Coming to rather more detail, each station submits weekly an estimate of its daily requirements during the succeeding week. Total requirements are then analyzed and allocated between the different suppliers, use being made of the holders to smooth out the daily load. As a matter of fact it is usually possible to ask for a uniform rate of supply from the coke ovens for five days in each week, with a small reduction at week-ends.

The agreements with the coke oven companies provide for facilities and access to the plants for the purpose of controlling the specification of the gas supplied to the grid system. Continuous control testing is carried out at the laboratory attached to the Grid Control Office.

In regard to maintenance, a squad of five specialized men is retained to deal with the mains, and, apart from regular routine work, in an emergency each of these men is competent to take charge of a full squad of mainlayers drawn from the undertakings supplied. A fitter and mate, trained in the maintenance of governors, are responsible for the plant at all stations.

Standby Gas Supplies

Generally all gas-works taking a bulk supply are dismantled, individual standby plants not being maintained. There are, however, certain key works which together have a standby capacity of 6 million cu.ft. per day. Two of the works take only a partial supply from the grid, and in an emergency can not only take up their own total loads, but also supply additional quantities back into the grid. Two other works, while normally taking a total supply from the grid, maintain their gas-making plants in first-class condition for emergency operation. *There is thus standby capacity available up to the maximum input of the largest single coke oven unit, while the cost of maintenance of many small standby units is avoided.* The coke ovens are widely spaced geographically, and with other safeguards it is believed that the position is fully covered.

One of the advantages of any grid system is that the trunk mains will pass through villages otherwise without gas. Such loads will usually not be large enough to warrant the erection of a holder and must thus be served through a governor direct from the grid mains. They will not normally be large enough to have an adverse effect on the hourly load factor, and continuity of supply in the event of the grid mains being temporarily shut down for maintenance purposes can be arranged either by looping the grid system, or by providing small standby boosters at the stations on either side of each village. Two villages are now supplied in this way. A third will be similarly supplied when the mains are extended.

Individual service connexions to the grid main are not permitted. The only supplies given direct are such as will justify the installation of a single governor and meter station, supplying perhaps 30 domestic consumers through a local low-pressure system.

Had not the war intervened, the main mileage for which statutory powers are available would have been much greater. Actually, since the formation of the Company a further three gas undertakings have been acquired by the United Kingdom Gas Corporation. The way is clear for the extension of the Distribution Company's limits of supply. Negotiations have been initiated with several undertakings but, on account of wartime restrictions, have been held up; it is anticipated that later they will be continued. It is apparent to us that the present nucleus grid could be readily extended to supply many more undertakings. In fact, the system was planned with this in view.

Achievement

The West Yorkshire Gas Distribution Company started to supply purified gas to certain constituent companies of the U.K. Corporation early in 1940. Before the end of that year all the companies in that area were connected to the grid and taking full supplies. We have mentioned that 17 undertakings are connected. Eight of these form a group constituting a proposed amalgamation, and while operating as separate undertakings, they are in fact co-ordinated under central management and control. We will refer to this more fully later. Three other undertakings comprise an amalgamation effected in 1940; two further undertakings are also operating under central management and control. In 1942 the amount of gas supplied to these undertakings by the grid was 2,929 million cu.ft.

The benefits accruing to the undertakings taking bulk supplies from the Distribution Company's system have clearly demonstrated the inherent soundness of its conception. In addition to the proved advantages of flexibility and adaptability, it has enabled the undertakings to develop gas loads which they could not normally approach without considerable extensions to plant and increase of staff. There has been a tremendous expansion in gas sales since the advent of grid gas in 1940; and it can be stated that with one or two exceptions none of the new loads attained since that date can be considered as purely wartime load.

The improvements directly due to the availability of adequate volumes of constant specification gas, coupled with centralized control, are clearly marked in the results of the group of eight undertakings which we have mentioned; this group represents a cross-section of industrial, residential, and rural areas. With this group the gas sales have increased from 391,679,000 cu.ft. in 1937 to 899,641,000 cu.ft. in 1942—an increase of no less than 130% over the period.

The total capital expenditure per million cu.ft. of gas bought has been reduced from £784 to £386 over the same period of six years. The incidence of developing loads on the total cost of gas is most marked. With one undertaking in the group in question the total cost of gas has been reduced by 163%. This in spite of increased costs arising out of war conditions and the fact that considerable expenditure has been incurred on major repairs to storage plant, &c., during the last four years.

UNITED KINGDOM CORPORATION

We have said that the working of the West Yorkshire Gas Distribution Company's scheme is bound up with the operation of the United Kingdom Gas Corporation. No account of the Company's activities and progress can be complete without reference to the development in organization of the parent Corporation, which now holds controlling interests in some 50 gas undertakings. These undertakings are situated in well-defined groups, and while some of the present subsidiaries are the result of amalgamations of individual undertakings carried out by the Corporation since acquisition, joint administration and working between other neighbouring undertakings has been established, resulting in substantial reduction of administration and overhead costs and improved service to the consumer. Twelve of the undertakings acquired by the Corporation have already been amalgamated. In addition, the promotion of Acts and Orders to authorize eight further amalgamations was in progress at the outbreak of war, but it has been necessary to hold them in abeyance for the time being. Notwithstanding the fact that amalgamations covered by the necessary statutory authority have been held up on account of the war, joint working and centralization of management is now operating in eight groups comprising 26 undertakings.

A most interesting feature of integration in the control of gas service is exemplified by the Radcliffe, Farnworth, and District Gas Company, where provision is made for the representation on the Board of the Company of the six local authorities which it serves. This arrangement has worked most successfully in the public interest. The practice of representation of local authorities on company boards was continued when the undertaking of the Morley Corporation was purchased. It has demonstrated the advantage to be derived from amalgamating direct public representation with virile private enterprise, and it is proposed to extend this policy as soon as circumstances permit to undertakings where local authorities have not been previously interested.

Constructional, Carbonizing, and Repair Department

For assisting its subsidiary companies the Corporation has established a constructional and carbonizing department under the control of expert engineers previously experienced in constructional work. The normal strength of this department employed in carrying out minor construction and repairs is approximately 100 skilled men, the rough labour in connexion with any work being provided in the companies themselves. This department has minimized the effects of a constantly decreasing supply of labour for the carrying out of minor repairs, normally undertaken by themselves; decreased output of new plant; the inability of contractors, because of labour shortage, to cope with the increased demand for repair work; and damage to plant by attacks from the air.

At the outbreak of the war there was in existence the nucleus of this organization, which has since proved itself an extremely valuable asset for coping with wartime difficulties. Greater use has been made of available surplus plant, and hence a greater saving of the country's raw materials and manpower. More essential repair and reconstruction work has been carried out than would have been possible had the companies been compelled to wait until contractors were in a position to undertake the work. The undertakings have been better able to meet new and increased demands for gas, because they have been assisted to keep pace with repairs and carry out some reconstruction. And finally, the undertakings have had their resources for dealing with air-raid repairs considerably augmented.

Industrial Gas Department

The centralized administration of the Corporation also includes an Industrial Gas Department, which has been responsible for direct assistance to undertakings in advising manufacturers and investigating fuel problems in their works. Many furnaces and appliances have been designed and constructed to meet manufacturers' special requirements. The selling of low-priced gas to industry and the development of the industrial load makes possible the selling of cheap gas to domestic consumers by increasing the gas consumption per consumer, and reducing proportionately all costs beyond the net cost of gas into the gasholder. This is well illustrated by the results at one of the constituent undertakings where, since the undertaking was acquired, the industrial load has been increased from 17% to 43.3%, and the total sales have been expanded from 2,181,000 therms to 3,693,000 therms per annum. The cost of gas, including all charges and loan capital interest in the year 1936, was 6.984d. per therm, and in the year 1942, 6.906d. per therm. During these years the actual price paid for coal has increased 110%; wages and all other charges are proportionately higher, but the incidence of the load factor arising from the development of the industrial load has resulted in the price being kept to a low level.

Again, considerable work has been done in the centralized training of the Home Service personnel employed by the subsidiaries, and in the training of the installation, maintenance, and fitting staffs. At present the Corporation's Home Service demonstrators are principally employed in collaboration with the Ministry of Food. The standard of service rendered to the consumer throughout the subsidiary undertakings has shown a marked improvement as a result of centralized service.

We may also mention the practice of the Corporation to provide skilled assistance in accounting and legal matters. The system of accounts, costing, and storekeeping is the same throughout all companies, and the results of all undertakings are available in all subsidiaries for the purpose of comparison. A standard of efficiency is established, and every assistance is given to local managers in the attainment of this standard as a minimum.

Local Initiative

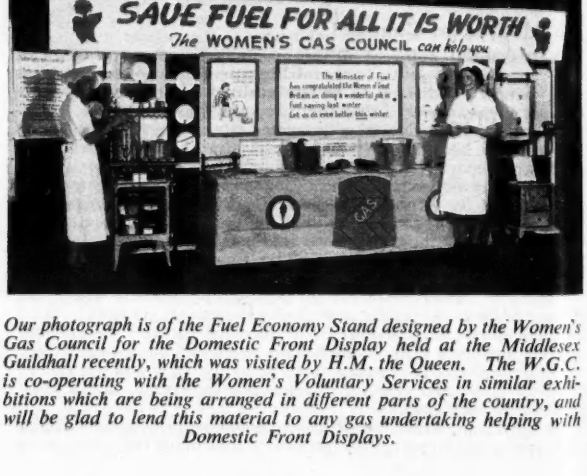
Finally, with all the assistance which can be rendered to the subsidiaries, in whatever direction, by the central organization, it is fully appreciated at headquarters that the success of the whole depends on the efficiency of the local managements. There is no interference with the initiative of the officers in charge of stations. Each man is as responsible as ever for the operation of his own undertaking; he works in and with the whole machine.

Fitting Girls for Post-War Jobs

As a contribution from the Gas Industry to the educational work of the Women's Services, ten display panels illustrating in colour the history of coal tar dyes, designed by the British Commercial Gas Association in collaboration with the British Colour Council, were presented at Gas Industry House on July 30 by Sir David Milne-Watson to Mrs. Laughton Matthews, Director of the Women's Royal Naval Service, for use in the Wrens' Education Department. In making the presentation, Sir David Milne-Watson said some of the war training of the women would have a peacetime value. At one W.R.N.S. training depot recruits were being turned into good cooks at the rate of 30 or more a week by the help of gas appliances. Such training should not only produce better housewives, but would also help to fit many of the girls into post-war jobs. In the Gas Industry, for instance, there would be many interesting jobs for intelligent girls. Its Home Service departments all over the country would have to be rebuilt, and it would need showroom managers and assistants, cookery demonstrators, dietitians, and advisers on all matters affecting women customers, and he was glad to feel that the women's Services would produce a pool of trained women for such work.

The immediate purpose of the display panels, however, was to draw attention to the scientific use of coal and the contribution which the carbonizing industries were making in producing over 2,000 substances from coal tar alone. The British Colour Council had gone to a great deal of trouble in securing the material for the panels, and provided some unique specimens of the ways in which coal tar dyes were used in the last war and the development of these processes which had taken place since, so that the range of colour had not only been extended, but also considerably brightened. Sir David added a word about the Gas Industry films, some of which were also being presented to Mrs. Laughton Matthews. Of the library of 31 different films the W.R.N.S. had chosen at least four to show at their various depots.

Mrs. Laughton Matthews briefly acknowledged the presentations, and, after tea, some of the films were shown to an audience which included several officers of the Navy, the A.T.S. and the W.A.A.F.



Our photograph is of the Fuel Economy Stand designed by the Women's Gas Council for the Domestic Front Display held at the Middlesex Guildhall recently, which was visited by H.M. the Queen. The W.G.C. is co-operating with the Women's Voluntary Services in similar exhibitions which are being arranged in different parts of the country, and will be glad to lend this material to any gas undertaking helping with Domestic Front Displays.

THE DESIGN AND PERFORMANCE OF GAS WORKS PLANT

Institution of Gas Engineers, June 9.

By A. G. GRANT, M.Sc., M.I.Chem.E., Assoc.M.Inst.Gas E.
General Manager, The Whessoe Foundry and Engineering Company Limited

At the end of the war the Gas Industry will embark on a considerable programme of new construction. Although essential renewals are being made during the war years, there will remain an accumulation of urgent demands for the replacement of plant which has been subject to wear and tear at normal or in some cases accelerated rates. It may further be assumed that planning on a regional basis will require the elimination of obsolete Works and plant with consequent provision of additional plant in the form of entirely new Works or to increase existing gas-making capacity. It also seems clear that there will be a great increase in at least the domestic use of fuels, and if the Gas Industry is to play its full part in this development it must be prepared for an expansion of its capacity perhaps on a large scale. Finally, the introduction of completely new processes must be visualized, representing improved methods of gas and by-product manufacture and the production of chemicals on a far broader scale than at present, these processes probably including the types of high-pressure and catalytic treatment plant which are rapidly coming to the fore in chemical industry generally.

The quantity of plant required in the post-war years will therefore be large, and it is of obvious importance that attention should be turned now to the correctness of its design, since the status and competitive power of the Gas Industry must depend in no small degree on the quality and efficiency of its plant units and processes.

A study of the technical growth of the Industry leads to the conclusion that improvement in plant has not kept pace with the many and great improvements in methods and processes. There is, however, a ready explanation of this anomaly. The manufacture and purification of gas, together with the working-up of by-products, are essentially chemical processes, and chemistry existed as a science at the inception of the Industry; the chemist therefore early turned his attention to gas manufacture and there has been an ever-increasing application of chemical investigation and control in gas works practice. The design of the plant in which these processes are carried out is, on the other hand, a matter for the chemical engineer, who is concerned with the correlation of engineering and process requirements. Chemical engineering, as an analytical science, is of relatively recent growth and probably it is this fact which explains the long history of empirical methods in the design of gas works plant.

In general, a large part of the plant at work today in the Gas Industry, and indeed in others of the older chemical industries, is not of the most efficient and suitable type. During the past twenty years, however, a considerable transition has occurred from empirical to scientific designing methods and much of the plant installed during this period has been designed with an understanding of the chemical engineering features involved. There is, nevertheless, a need for further thought and work on critical lines to ensure that all future plant is in every way efficient and suited to its purpose. To this end a full appreciation of the scientific attitude to both design and performance is of first importance and it is the argument of the Author that this appreciation is necessary in the user as well as the designer.

Plant Design

Empirical Methods

Gas manufacturing processes were originally simple and to a large extent uniform in type. A particular design of plant could therefore be expected to operate effectively at any Gas Works if adjusted in size simply in relation to the coal carbonizing rate of the Works or retort house. This simple basis of design presupposed that coal throughput was the only variable and that many other factors such as coal type, carbonizing conditions, and yields of gas and by-products were constant. Probably this was then the case, and as plant supplied in the face of little competition often included a large or even extravagant safety factor, its performance was not unsatisfactory.

Subsequent developments in design, until the advent of true chemical engineering methods, continued within the realm of pure empiricism. It was, for example, learned that gas yields varied according to coal type and carbonizing conditions, and the design of gas treatment plant was therefore related to gas volume and no longer to coal throughput. A step forward of this type, however, eliminated only one variable and was in no way an approach to the scientific attitude. Until the Great War plant was designed almost exclusively on the basis of tons of coal carbonized or cubic feet of gas treated per day, and such plant usually performed its main duty satisfactorily but was often not efficient in an all-round sense. A common method of attack was to list the empirical rules of various authorities along with parallel values from any available experience, and to use the most liberal designing figures if cost allowed or alternatively to adopt what appeared to be a reasonable mean. The result was usually a unit which was satisfactory for normal conditions but might not be effective in certain circumstances for which it was ostensibly designed.

These purely empirical methods were in fact the rule-of-thumb application of trial-and-error experience. There was usually some critical factor ignored and there could be no attempt at proper correlation of results and experience, since the picture was at all stages incomplete. Such methods were practicable and perhaps justifiable when processes were simple and uniform, and in the absence of the data and the understanding which are the basis of scientific methods. They became unsound as soon as gas manufacture became complex and particularly when the steamed vertical retort introduced new types and yields of gas and by-products. Empirical corrections of the older empirical rules to meet wide variations in duty and conditions naturally failed to produce the efficient plant that was required, and there was in consequence every incentive to an entirely new and more informed attitude to design.

Scientific Attitude

The essence of the scientific attitude is that the fullest theoretical analysis of any problem should preface and form the basis of calculation, observation and experiment. This analysis ensures a proper appreciation of the problem in all its aspects. It shows what quantities, properties and effects are involved; how each may be evaluated or determined; and how they are inter-related. It enables the fullest and correct use to be made of established data and physical constants. It allows of any unknown effects or values being clearly defined and critically sought. It precludes the loose and uncritical obtaining of experimental results which are of restricted or of no scientific value. Where empirical values are unavoidable, theoretical analysis reduces them to fundamental terms and avoids their selection or determination in relation to a particular and unduly local set of circumstances. In other words, by using theory to the fullest extent the scientific attitude reduces a problem to its fundamentals and so eliminates, or at any rate minimizes, its non-universal elements.

The estimation of pressure drop in pipes well exemplifies the difference between the purely empirical and the scientific approach. On an empirical basis it is difficult to visualize the mass of figures that would be required to give pressure drop values for all gas mixtures flowing at various velocities, temperatures and pressures through pipes of varying diameters and degrees of roughness. There could never be figures available to meet every case and too often unsuitable data would be used. On the other hand, theoretical analysis has shown the inter-relation of these variables in the Reynolds Numbers, and subject to proper selection of these Numbers in relation to roughness of pipe walls, pressure drop problems can be solved in a logical manner using figures applying to each particular case.

Another example occurs in the design of so-called gas con-

densers, which constitute an interesting case in the wide chemical engineering field of heat transfer. Theoretical analysis shows that the heat transfer duty of a condenser depends on gas throughput, temperature, and degree of saturation, and that it can be calculated from known theory and data; that the heat transfer rate from gas to cooling water depends not only on gas temperature and saturation and on temperature gradient between gas and water, but also on the dimensions and arrangement of the tube surfaces and on gas and water velocities; and that water consumption is determined not only by temperature differences, but also by the heat transfer properties of the tube surface. The corresponding design calculations are somewhat complex, but it will be seen that a design using empirical values for cooling surface and water consumption related solely to gas throughput is thoroughly unsound. In fact, the surface per unit gas volume per hour calculated scientifically may vary by several hundred per cent according as the gas to be cooled is derived from horizontal retorts or modern intermittent vertical retorts.

Coefficients

In the scientific design of plant the conception of coefficients is of fundamental importance. In this sphere a coefficient is the connecting link between process duty and plant dimensions. In other words, it is one of the basic concepts of the chemical engineer, who is almost entirely concerned with the correlation of plant and process. In heat transfer work, for example, the coefficient relates heat transfer rate to temperature gradient and heat transfer surface. In scrubbing it relates vapour removal rate to vapour concentration gradient and scrubbing surface. The coefficient is scientific in its basis and application (although often empirically determined) in that it is related to physical values capable of a correct determination, and its own value may be corrected in accordance with subsidiary variables. For example, a heat transfer coefficient is related to temperature difference, surface and time, all of which are exactly determinable, and it can be corrected in a known manner for changes in gas properties, velocity and other variables. The older empirical designing figures on the other hand were not scientific in that they took no account of many variable factors which in fact might entirely invalidate them.

Scientific Approach

Throughout the whole range of gas works plant the scientific attitude to design is necessary—in the design of retorts, producers, and recuperators; of offtakes and gas mains; of liquor separating and flushing systems; of condensers, tar fog extractors, scrubbers and purifiers; of by-product plant and its ancillaries. Indeed a Gas Works provides as wide a variety of chemical engineering design problems as any branch of chemical industry. In every case, correct design can result only from full theoretical analysis, the informed use of known data and the critical determination of experimental values which should be of basic type and of as nearly universal application as possible. The final addition of a determinate safety margin is then a matter of experience, but its purpose is to cover the unexpected and not those known factors for which proper allowance ought to have been made.

In the selection and designing of plant for new purposes it is of paramount importance that generalized thought should be avoided, and that there should be a scientific approach to the problem, with proper investigation of all essential physical and chemical factors. In this connexion a valuable lesson may be learned from the attempts which have been made to deal with aerosols occurring throughout chemical industry—metal fume, acid mist, flue dust and tar fog being examples. It was for long not realized that the removal of these suspensions was basically a difficult problem, and many and various plants and types of apparatus were unsuccessfully installed. Today it is known that tar fog particles, as one example, are among the finest physically-suspended matter in industry, and by calculation it can be shown that most ordinary extraction apparatus is quite unsuited to their efficient removal. In fact a full understanding of the behaviour of fine particles in suspension is an essential preface to any thought of methods for their removal. Similarly with other new problems; investigation and evaluation must precede the selection or design of plant

The Two Sides of the Gas Industry

With notable exceptions the main contribution in the advance from empirical to scientific understanding of plant design in the Gas Industry has been made by the supplier of plant, equipment and processes—the contractor. The user, on the other hand—the gas engineer or chemist—has been concerned largely with the results obtained. Whilst there has thus been a contribution of major importance from one side of the Industry to the other, it has not always been appreciated by gas engineers.

The difference in size and efficiency between gas works plant of forty years ago and that of today is due in the main not to trial-and-error methods, but to the increasingly able scientific attitude of the contractors' designing staffs. This fact reflects no especial credit on the contractor, as it is his duty to understand and improve the plant and processes in which he is a specialist; but a more general appreciation of it among gas engineers should do much to bring about a more active technical collaboration between the two sides of the Industry. The Author believes that this collaboration is of prime importance to the Industry in its post-war development.

The Gas Industry is a great chemical industry and it carries out large-scale chemical processes in perhaps a wider range and variety of chemical plant than exist in any other chemical field. The technical literature of the Gas Industry, moreover, is considerable in quantity. In reflecting the thought of the Industry this literature shows, however, how one-sided is gas works science today. The gas engineer or chemist places the results of his work freely at the disposal of the Industry and to this there is no deterrent, as Gas Undertakings do not compete among themselves. The contractor, on the other hand, must compete, often in an unrestricted field, and is reluctant to publish the technical information which is a large part of his stock in trade. As a result there is available a vast body of information on gas works chemistry and processes, but all too little on the design and fundamentals of the chemical plant in which the processes are carried out.

This state of affairs is clearly not in the best interests of the Industry as a whole. The user is not properly informed regarding the plant he installs, and the supplier cannot therefore obtain the understanding collaboration he would wish. There cannot be the effective development which would result from more full and active co-operation between the two sides of the Industry.

The Scientific Attitude to Performance

Both user and designer have a vital interest in long-term performance; the user because this more than installation tests determines the usefulness of the plant, and the designer because he is not interested primarily in the proof of his design but rather in the correctness of his plant in a permanent sense. Whilst the designer too often is unable to maintain close contact with his plant, once it has been initially proved, the user necessarily must live with it, and it is here that he can make such a valuable contribution to both sides of the Industry, assisting in the elimination of initial short-comings and providing operating data and experience to form the basis of future development and improvement.

It is the suggestion of the Author that the user of chemical engineering plant—the gas engineer or chemist—should take a more critical interest in its performance; that he should from the outset take every care to understand the theory and basis of its design; and that his subsequent tests and observations should be from a scientific angle with critical and correlated assessment of the various factors in its performance. He should not content himself with superficial measurements to ensure that the plant is carrying out the overall duty required of it. He should instead make observations with the broader object of properly analysing performance under various operating loads and conditions and after various terms of service. In this way he will glean information rarely available to the designer and will be able to make a real contribution to chemical engineering progress. With a live and informed interest on the part of the user it would seem that the wide chemical engineering side of the Gas Industry must advance rapidly. Not only will the literature cease to be one-sided in its contribution to gas works science, but the two sides of the Industry will be brought technically together.

Whilst the contractor ought still to make the major contribution to advancement in design, the user will on his side have valuable information to give. One will stimulate the other and progress will be inevitable.

Today the able contractor is discouraged from disclosing his data and methods from fear more of uninformed competition than of other equally able contractors. This situation is in some degree the result of the inability of the user to understand and assess the plant offered to him. Too often a contractor with little knowledge of his subject is able to offer at low cost a fair imitation of the proved plant of his better-versed competitor, and the user, attracted by low first cost, gives the encouragement sought. The able contractor is thus discouraged from the more expensive fields of research and development.

It is only by the growth of a keen interest in the scientific aspects of plant design and performance that this state of affairs can be remedied. The informed buyer will of necessity offer that encouragement and security which is so necessary to the better type of contractor. The contractor will with confidence improve his products in all possible ways even though it may increase their first cost. His standards for design and performance will rise, and he will cease to be hampered by imitative competition. He will for the first time feel free to make his proper contribution to technical literature and discussion.

In brief, a greater interest and understanding on the one side of the Industry will invoke higher standards and greater enterprise on the other. Only out of their joint contributions will come that advance in quality and efficiency which at this time is so necessary.

The Need for Higher Standards

The Author's theme in this short Paper is the paramount necessity of the scientific approach in all phases of the design and operation of gas works plant. Too often the Works approach is on so-called practical lines. Observations are made and results collected with too little understanding of their significance and inter-dependence. Particularly in the case of reports on plant are salient factors omitted, or observations made without reference to the operating conditions at the time. Is it too much to plead that any routine test, full-scale investigation, or simple search for the cause of a particular trouble be prefaced by a theoretical analysis of the problem and an understanding of all significant factors requiring determination? When results have been obtained, can they be considered critically, and rejected in part or in whole if they do not withstand this criticism? When a report is finally made can it contain figures of absolute value, so that at some future date these figures can be applied to parallel circumstances without the necessity to estimate some missing value?

It would seem that the general attainment of these higher standards in the Gas Industry is made at once more necessary and more certain by the existence of the Gas Research Board The main work of the Board is the conducting and co. ordinating of the fundamental research of the Industry, and its work in this sphere is and must continue to be at a high level of scientific thought. Its attack on problems is and must remain sound, and its deductions reasoned and critical. If its results are to be properly assessed and applied in everyday practice, there must be an approach to them by the Industry on scientific lines. The very work and publications of the Board will, however, encourage this type of approach, and it is possible that a major contribution the Board can make to the Gas Industry is in inculcating into the work of the Industry its own standards of thought and criticism. Indeed the Gas Research Board can and ought to become the arbiter of scientific thought in the Industry it serves.

Conclusion

Considerable advances have been made in recent years in the design of the chemical engineering plant used in Gas Works. The large building programme envisaged after the war and the anticipated competition among the fuel industries require that all new plant should be of the highest standard in its performance. The contribution to this end being made by the Gas Industry contractors can be greatly enhanced if there is within the Industry a wider understanding of plant design. Informed selection and buying of plant will encourage enterprise and development on the part of the contractors and will discourage the selection of plant the only virtue of which is its low first cost.

Whilst the need for the scientific approach has been recognized in gas works chemistry and processes, its application to gas works plant will foster that greater collaboration and sympathy between contractor and user which appears necessary if the highest standards are to be reached and maintained.

"INFRA-RED" BY GAS

The following is a report of the discussion on the Paper "Radiant Heating for Industrial Processes. Infra-Red by Gas," by L. W. Andrew and E. A. C. Chamberlain, to the Institute of Fuel on July 21 —see "JOURNAL" of July 28 and Aug. 4.

Dr. **J. G. King** (Director of the Gas Research Board) said that the advantages of heat transfer by radiant heat had been recognized for many years. One example was the claim made by Bone and McCourt that surface combustion provided a means for obtaining high temperatures without regenerative devices and of transferring heat rapidly by radiation. In order to further the work at Leeds, a recording infra-red spectrometer had been purchased which had accelerated progress. Incidentally, a considerable amount of work had been done upon selective radiation by Dr. Hartley in connexion with gas fire radiants.

The Authors had rightly pointed out that in general terms infra-red heating was not a new discovery, since it involved all the principles of heating by radiation which were so familiar. The meaning of heating by radiation, however, could not be too clearly defined at the present stage. Even the Authors used the words infra-red and radiant heating in a way which might be confusing to some readers. He would like to see the subject dealt with under the general heading of "heating by radiation" with, however, an explanation of exactly what was meant. The Council of the Gas Research Board had recognized this difficulty, and was preparing an explanatory leaflet for distribution throughout the Industry. Heating by radiation had had many applications in the past, but he saw many extensions which would give improved efficiencies. Some were suggested in the Paper. There was also the possibility of controlled heating by radiation in which the distribution of energy in the infra-red band was chosen to suit the absorption characteristics of the objects to be heated. It was in this direction that the Gas Research Board was aiming to study fundamentals, such as the energy distribution curves and absorption properties of different surfaces. It would be apparent that in a drying stove or furnace working on a steady stream of similar objects, one might achieve a higher efficiency by selective radiation than would otherwise be possible. The Authors were quite right to point out that it would not be wise to claim that heating by radiation was applicable to all problems of heating or drying.

There were other considerations upon which fundamental data were still required and which would repay examination. For example, in the drying of paints, information was required not only on the most suitable wavelength of the radiation and the rate of heating to suit the colour, but also upon the possible absorption of the radiation by the vapours of the solvents used. It was known that the vapours of organic solvents absorbed certain wavelengths preferentially. The same problem arose in the drying and firing of ceramics. Here, again, the fundamentals required examination, since it was not certain that the best firing conditions were those which gave the highest rate of heat transfer. Emission and absorption were surface effects, and the rate of penetration of heat into the object could be more important. In the melting of glass this had a special significance, since glasses were transparent and also had variable absorption characteristics. Emissivity data regarding the surface of refractories were also of interest to the iron and steel industry. Incidentally, in the drying of paints, radiant heat had certain advantages not stated by the Authors.

The Gas Research Board was interested not only in the application of radiant heating described in the Paper but in the whole field, and he would like to see serious consideration extended both fundamentally and by development work to all forms of radiant heating. He had been interested to read a reprint published by the Committee of Industrial Gas Research of the American Gas Association, in which they had applied direct radiant heating to the firing of ceramics, using a multiplicity of incandescent ceramic cups distributed over the cooling walls. He would like to see developments of this type taking place in this country.

Mr. **Matthews** (I.C.I. Paints, Ltd., Slough) wished to emphasize the principle involved in infra-red stoving—*viz.*, that it was necessary to take the article out of the stoving apparatus while the temperature was still rising. If that necessity had been grasped many of the problems which had arisen would have been avoided. It would be useful if suggestions could be made for reducing or increasing the radiation in different parts of the oven by some more simple means. Had the Authors any alternative scheme for doing this?

Dr. **Margaret Fishenden** (Imperial College of Science) said the time taken for any sheet to reach any given surface temperature depended

on the coefficient of heat transmission to the plate, the plate thickness, the thermal conductivity and the thermo-diffusivity of the plate material. If the necessary physical constants were known, the time taken for the plate surface to reach any given temperature under any given heating conditions could be calculated by methods that were rather more precise than the ones used by the Authors. Nothing had been said about the latent heat of vaporization of the solvents used. Again, the results of different observers showed that the darker colours had higher absorptive powers than the lighter colours, although as the temperature went down the differences became smaller.

Mr. **Massey** (Donald MacPherson & Son) said that as a paint manufacturer he welcomed any work on the problem of hardening paint films which assisted in reducing the time factor in certain operations. The use of infra-red radiation made a considerable contribution in this connexion.

Mr. J. **Hanning** (Incandescent Heat Co., Ltd.), in a statement which he read on behalf of his chief, Mr. Fallon, said the process described in the Paper had been widely applied for many years and it was particularly well known by the technologists of the Gas Industry, but it had been re-invented or perhaps, more accurately, re-discovered by the electrical industry. Large scale plants for heating coated plates of relatively light substance—*e.g.*, 30 gauge, at temperatures exceeding 1,000°C.—from a radiation source of 1,300°C., were used by the Gas Industry both in this country and the U.S.A. some 13 years ago.

Mr. **Saunders** (Pinchin, Johnson & Co., Ltd.) said there was a tendency to exaggerate the speed with which paint could be dried by infra-red radiation, and this was also shown to some extent in the Paper. There was also a difference in the various types of paint and the rates at which they dried. In this case, however, his experience had been that the differehces were not so great as suggested in the Paper.

Dr. **Nelson** (Joseph Lucas, Ltd.) said the electrical people had forced action in this matter and had actually done something. Indeed, they had dried paint quickly, and previously that had not been done. The Authors showed that the Gas Industry could also do it as well, and possibly better, however.

Dr. **Roberts** (Leeds University) said it might be that if the object being heated was radiated by a selective radiation, which was itself absorbed preferentially, a higher efficiency or a more satisfactory product would result. Further investigation should be devoted to this point of view. Mentioning a practical point with regard to the design of the Author's furnace concerning the temperature distribution in the tunnel, he asked how far, if at all, this would be altered by the existence of a cold body at the entrance at a lower temperature, and a higher temperature body at the end, assuming a continuous stream of objects passing through the furnace. If there was an effect in this regard, would it not be possible to adjust the gas rate to compensate for it?

Mr. **Sturdy** (Controlled Heat & Air Co., Ltd.) said that having ascertained the views of the gas people with regard to electric radiation and the views of the electrical people with regard to gas radiation, he had gone into the question of what this type of radiation was going to cost in the heating of a painted article or any other body. It was here that he thought the gas radiation apparatus would score even more considerably than had been indicated in the Paper. The installation charges for the gas apparatus were very much lower than for the electric, and in an investigation of a similar gas and electric plant he had found a difference of 25% in favour of gas. Further, there was no cleaning required with the gas plant, and therefore it was not so necessary to make the gas plant portable. It was the fact that the electric plant had to be cleaned so far as reflectors, &c., were concerned that rendered it necessary such plant should be portable. There was also the question of the breakage of lamps during the cleaning process, which had been found to be considerable and, indeed, amounted to hundreds of lamps. Another advantage of the gas-heated plant was that cellulose articles could be treated more safely owing to the danger with an electric apparatus the cellulose might "flash" due to a short circuit or bad connexion in the lamp or wiring. Continuing, he said it seemed to be overlooked that this form of treatment by gas or electricity had a very wide application for the heating of liquids and bodies other than for paint drying, and where the intensity of the radiation was the deciding factor. He believed that gas would score in that connexion, for it would give the most intense form of radiation in the shortest time at the lowest cost.

Mr. **Gilman** (Electrolux, Ltd.) remarked that it was common practice with the convector oven to pass through objects of different gauge material at the same time, and they all seemed to come out satisfactorily, but that did not appear to be economically possible with radiant heating. As regards maintenance, there was a great deal of cleaning of reflectors and replacement of lamps with the electric apparatus, but he would like a few details as to the maintenance of the gas plant. For instance, were flue deposits likely to form at the back of the radiant panel, and what was the life of the radiant panel and the burners, because these were important points in regard to costs? Were any comparative costs available of radiant and reflector heating?

Mr. **F. L. Atkin** (Birmingham Gas Department) said that a similar unit to that used at Watson House, but differing in a few details, had been made and installed by the Birmingham Gas Department's Industrial Research Laboratories. Tests on this unit had confirmed the Author's findings. To prevent possibility of spoiling when using radiant energy, the use of a heating medium which was flexible as distinct from a fixed source of radiant energy was indicated, so that a constant conveyor speed could be used which would interlock with production requirements. A unit producing an adjustable flux density had the advantage of enabling a variety of paints to be dried for a given conveyor speed and avoided the necessity of laboratory predeterminations. The convection oven, however, would still be used, particularly in peacetime, where a variety of shapes and masses would have to be dealt with by the same drying unit. He thought the future would see convection heating incorporated with radiant heating. In many cases single line conveyors had the advantage that they could be utilized for other operations, such as spraying, thus avoiding reloading on to a separate conveyor, the reduction of storage capacity of the oven which had to be allowed for at the beginning and end of a shift, and reduced floor space—but unless one assumed that rapid drying produced an improved product, it mattered not from the production angle whether 60 articles took one hour each to dry or one article took one minute ; it was solely a question of handling.

Mr. **A. C. Jennings** (Derby Gas Light & Coke Company), remarking that the subject of the Paper was one to which many in the Gas Industry had been giving attention in recent time, said that if the Paper could be criticized at all it would be because the question of selective radiation and source temperatures had not been discussed in the detail he would have liked. He found that by using radiant heat for drying, the water could be driven out of the interstices of the rubber well beneath the surface, which could be kept at a comparatively low temperature. In other words, it appeared to him that the water contained in the rubber cushion was opaque, at any rate at certain wavelengths of radiation, and absorbed them, whereas the rubber enclosing the water particles allowed the penetration of these rays, at any rate to a depth approximating to 1 in. The point then was this: The majority of drying installations used in industry were concerned with the evaporation of water from, say, cores, furs, wood, &c., and if by selecting the wavelength in which the bulk of the heat was to be transmitted, good penetration resulted, some work should be done on the possibility of selecting such wavelengths. Perhaps investigations would show that it would be possible to treat the radiant source with chemicals or rare earths in the same way that incandescent gas mantles were treated, to decrease the wavelengths emitted.

Dr. **Silman** (Joseph Lucas, Ltd.) stressed the great importance of convection control in a radiant heat oven of any description. Although both the Authors and the electrical people stressed, almost as a virtue, the fact that the temperature inside the oven was not more than 25° above the temperature in the room, they all overlooked the important point that as the articles being heated reached a higher and higher temperature, they were constantly radiating heat at a very high rate. It therefore followed that to bring the articles up to between 300° and 350°F. the heat loss would be extremely high, and to maintain the highest possible thermal efficiency the aim should be to have as high a temperature as possible inside the oven.

Mr. **Burt** (Birmingham Electricity Department) said there was a lot of paint flying about in a factory plant and what happened to that? With hundreds of articles passing through day and night, the inner surface of the oven would be appreciably altered and something would have to be done to remove this paint. Further, let no one have the idea that infra-red lamps were the last word of the electrical people. Improved devices were coming along.

Mr. **Cabor** suggested that the cleaning bugbear had been made too much of by various speakers. It had been found that with proper ventilation the reflectors did not need to be cleaned as often as was supposed by some people; and, again, further developments would no doubt produce, as in America, lamps and reflectors which the paint would not affect in the same way that it did now.

Mr. **A. Watson** (F. J. Ballard & Co., Ltd.), speaking as a plant manufacturer, remarked that gas was not so far behind as had been suggested by Dr. King. There were gas radiant ovens in use for various processes in the high intensity range and they dried paints bone hard in as short a time as 40 seconds. The discussion had been mainly confined to low intensity radiant heating, but equally good results were to be obtained in the infra-red oven. Gas radiant reflectors had also been developed, and time would show the advantages and disadvantages of the reflector type infra-red as compared with heating by radiation. There had been so much publicity with regard to infra-red that many manufacturers were beginning to wonder whether they were not missing something. On that matter he advised caution, because one mistake or one dissatisfied customer would do the Gas Industry a great deal of harm, and certainly plant manufacturers could not afford to rush in and advise all and sundry to scrap their convection ovens and install the radiation type. Every problem should be carefully considered in relation to the conditions to be met, and it was the duty of the manufacturers to advise their customers as to the most suitable type of oven or process to be used. All types had their applications. He had recently investigated the use of the radiant heat and the convection oven for a particular article, and in that case found that with the exception of the advantage of using an assembly conveyor, all the advantages were with the convection oven. The convected heat oven of the conveyor type cost

£600; the gas consumption was 250 cu.ft. per hour and, assuming 2s. 6d. per thousand cu.ft., this amounted to 10½d. per hour. The box type convected heat oven cost £400; the gas consumption was increased to 500 cu.ft. per hour, or 1s. 3d. The radiant heat oven or radiation convection oven with conveyor cost £1,000; the gas consumption was 700 cu.ft., or 1s. 9d. per hour. The electric infra-red oven, with conveyor, similar to a gas radiant oven, cost £1,500 and the consumption was 36 kw.-hours, which, at 0.65d. per unit, cost 2s. per hour. Thus, unless a conveyor line was put in, the convection oven had the advantage. In another case a convection type conveyor oven to deal with an output of 360 cans per hour consumed 1,800 cu.ft. per hour, and at 2s. 6d. per 1,000 cu.ft., this cost 4s. 6d. per hour. A gas radiant oven to do the same work required a gas consumption of 3,000 cu.ft., which amounted to 7s. 6d. per hour, and an electric infra-red oven required 2,000 units at a cost of 11s. per hour. As a plant manufacturer he was in no way biased in favour of the convection oven. He was out to do his duty and advise his customers as to the best oven to adopt for the particular purpose, but he did wish to give a warning against rushing in and advising the use of radiant heat ovens for every purpose.

INSTITUTION OF GAS ENGINEERS EXAMINATION RESULTS

The undermentioned candidates were successful in the 1943 Examinations in Gas Engineering (Manufacture), Gas Engineering (Supply), and Gas Supply of The Institution of Gas Engineers.

EXTERNAL CANDIDATES (27).

Diploma in Gas Engineering (Manufacture) (7).

Class.	Name.	Town.
First ...	Gilden, G. ...	Hampton Wick
Second ...	Derbyshire, K. ...	Bangor, Co. Down
„ ...	Grundy, J. M. ...	Bolton
„ ...	Keywood, H. C. ...	Blackburn
„ ...	Shilson, A. C. ...	Tottenham
„ ...	Tilley, J. G. ...	Macclesfield
„ ...	Woodcock, J. A. ...	Yeovil

(All the above candidates took the Home Paper, in lieu of submitting a Thesis.)

Higher Grade Certificate in Gas Engineering (Manufacture) (4).

Class.	Name.	Town.
Second ...	Ferguson, D. ...	Liverpool
„ ...	Kenworthy, H. W. ...	Sheffield
„ ...	Taylor, M. H. ...	Clitheroe
„ ...	Willis, A. J. ...	Romford

Ordinary Grade Certificate in Gas Engineering (Manufacture) (10).

Class.	Name.	Town.
First ...	Fairman, J. R. ...	Southampton
„ ...	Sanders, A. W. S. ...	Birmingham
Second ...	Allcock, W. ...	Rochdale
„ ...	Attwooll, R. H. ...	Rochester
„ ...	Baker, D. A. ...	London
„ ...	Bignell, W. G. ...	Eastbourne
„ ...	Holland, R. H. ...	Wellingborough
„ ...	Houle, G. ...	Halifax.
„ ...	Painter, F. J. ...	Darlington
„ ...	Totty, E. A. ...	Newcastle upon Tyne

Diploma in Gas Engineering (Supply) (3).

Class.	Name.	Town.
First ...	Porter, W. H. B. ...	Stockton-on-Tees
Second ...	Denoon, J. R. ...	Edinburgh
„ ...	Ricketts, T. S. ...	Tottenham

(The three candidates for the Diploma in Gas Engineering (Supply) took the Home Paper, in lieu of submitting a Thesis.)

Higher Grade Certificate in Gas Engineering (Supply) (2).

Class.	Name.	Town.
Second ...	Ernest, K. M. ...	Penarth
„ ...	Johnson, W. H. ...	Lowestoft

Ordinary Grade Certificate in Gas Engineering (Supply) (1).

Class.	Name.	Town.
Second ...	Medlin, R. L. D. ...	Falmouth

Serving Overseas.

INTERNAL CANDIDATES (20).

Higher Grade Certificate in Gas Engineering (Manufacture) (8).

Class.	Name.	Centre.
First ...	*Pilling, R. ...	Manchester
Second ...	Bowman, N. R. ...	Manchester
„ ...	Buckley, F. C. ...	Manchester
„ ...	Christie, J. T. ...	Glasgow
„ ...	Kehoe, E. F. ...	Manchester
„ ...	Kerr, F. B. ...	Glasgow
„ ...	Rees, W. D. ...	Cardiff
„ ...	Woodcock, J. ...	Burnley

* This candidate passed with Distinction.

Ordinary Grade Certificate in Gas Engineering (Manufacture) (7).

Class.	Name.	Centre.
First ...	Vigus, K. W. ...	Dudley
„ ...	Wickstead, N. ...	„
Second ...	Campbell, A. ...	Glasgow
„ ...	Cornock, J. S. ...	„
„ ...	Sharp, J. ...	Bradford
„ ...	Smethurst, L. B. ...	Manchester
„ ...	Smith, B. C. ...	Bradford

Higher Grade Certificate in Gas Engineering (Supply) (2).

Class.	Name.	Centre.
First ...	Barker, F. C. ...	Bradford
Second ...	†Dow, D. C. ...	Glasgow

† Certificate to be endorsed.

Ordinary Grade Certificate in Gas Engineering (Supply) (3).

Class.	Name.	Centre.
Second ...	Ball, E. ...	Westminster
„ ...	Blackburn, H. ...	Bradford
„ ...	Stanger, R. H. ...	Westminster

REPORT OF THE BOARD OF EXAMINERS

During the year 1942–43 the members of the Board of Examiners and Assessors appointed by the Council were:

Major Courses:

Examiners: L. P. Ingram, M.Sc., A.I.C. (Loughborough), Chairman; F. Dawson, B.Sc., Assoc.M.Inst.C.E. (London); G. Dougill, M.Sc., A.I.C. (London); G. H. Kenyon, M.Sc.Tech. (Sheerness); A. McDonald, B.Sc. (Castleford); H. S. Milne, B.Sc.(Eng.) (Aberdeen); E. O. Rose, B.Sc. (London); H. H. Thomas, B.Sc. (Liverpool) —Gas Engineering (Manufacture). J. H. Dyde, M.Sc. (Uxbridge); W. A. Bishop (Croydon); W. H. Blundstone, B.Sc. (Newark); D. C. Gunn, B.Sc.(Eng.) (Leeds); A. C. Rea, M.I.Mech.E. (Bath); W. N. Smirles, B.Sc. (Birmingham); W. K. Tate, M.A. (London); J. E. White (Newcastle upon Tyne)—Gas Engineering (Supply).

Assessors: Gas Engineering (Manufacture) and (Supply). West of Scotland: David Fulton (Helensburgh); Sydney Smith (Paisley). East of Scotland: D. D. Melvin (Edinburgh); J. W. Napier, M.B.E. (Alloa).

Minor Course and Gasfitting Courses:

Examiners: E. F. Keable (Worksop)—Gas Supply Practice. R. N. LeFevre (London), A. G. R. Kennet (Margate), J. Robertson (London) —Gasfitting. A. Mardsen (Bristol)—Elementary Science.

Comparative Schedule of Examination Candidates.

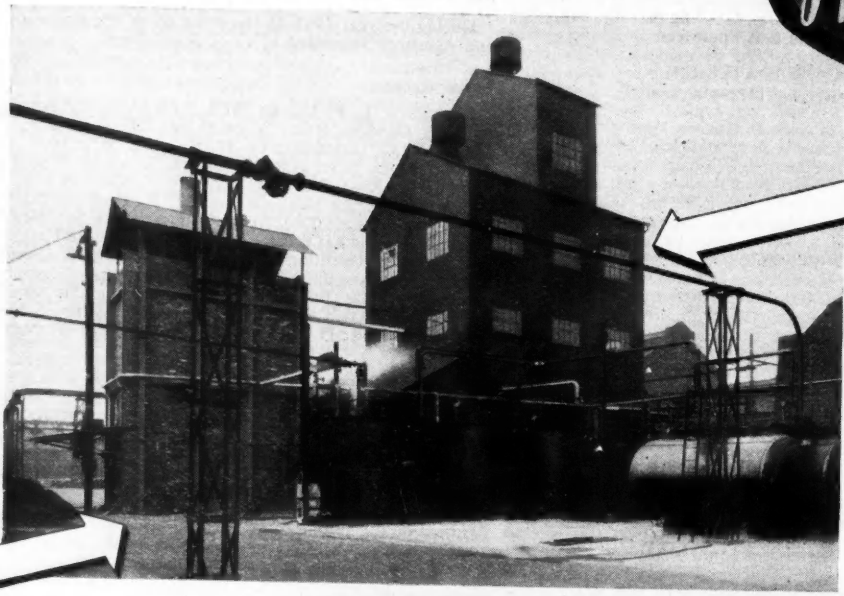
Subject.	Grade.	1942. Internal.	1942. External.	1943. Internal.	1943. External.
Gas Engineering (Manufacture) ...	Ordinary ...	29	28	29	29
	Higher ...	12	20	22	22
	Diploma ...	—	4	—	12
Gas Engineering (Supply) ...	Ordinary ...	14	17	7	11
	Higher ...	11	7	7	12
	Diploma ...	—	2	—	7
Certificate in Gas Supply	... ...	—	1	—	—
Total ...	... ...	66	79	65	93
Grand total ...	... ...	145		158	

Examinations, 1943.

This is the first year in which the Home Paper has been included as an alternative to the Thesis in the Diploma Examination and, in consequence, it calls for a special note. The innovation was generally welcomed by candidates, since of the 19 who sat for the Diploma Examination in Gas Engineering (Manufacture) and (Supply) not less than 16 took the Home Paper. The results, however, were disappointing. Only three candidates in all submitted papers up to first-class standard. Two of these were outstanding and showed that the candidates really knew their work, but many others were either failures or borderline cases. The questions were definitely practical, and were designed to allow students to show their initiative and ingenuity. The ability to submit a finished, clearly expressed, and logical report was lacking.

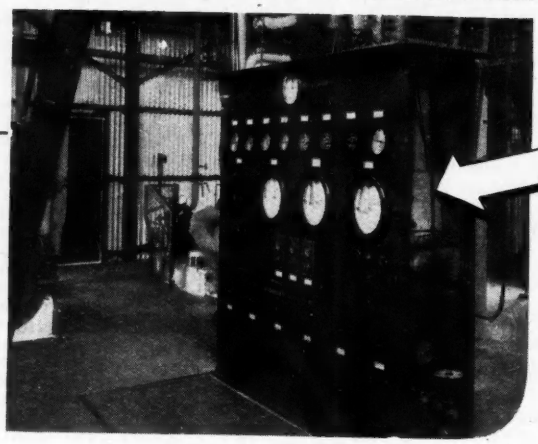
Of the rest of the examinations, it can only be said that the results are very disappointing, the percentage failure being generally about 50. It is difficult to account for such a low standard, but it is believed that similar results have been experienced by other Examining Bodies. One can only assume that it is partly psychological, and indicates, in part, a lack of ability to concentrate under present conditions. The Examiners regret to note that spelling mistakes, even of simple words, are common. There are some who never learn to spell correctly, but apart from such few extremes one does not expect bad spelling in professional examinations. The Examiners again have to comment adversely on sketching in all grades. It seems desirable, therefore, to endeavour to give some constructive criticism for the guidance of both teachers and candidates. In doing so it must be remembered that all candidates before entering the Institution's Examinations have had to pass an examination in engineering drawing. All candidates should, therefore, have had some training in making free-hand sketches.

TAR DISTILLATION SIMPLIFIED BY Wilton PLANT



HERE THE PRODUCTS COME OFF CONTINUOUSLY

HERE IS THE FIRE



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Dimensional sketches are not asked for; only free-hand sketches are required, and these can frequently be diagrammatic. They ought, nevertheless, to be neat, clear, and reasonably proportional, and clearly and neatly lettered. They should not be scrawled like the drawings of a child who has no notion of, or training in, sketching. It must be emphasized that a neat, clear sketch will save a long description, and show an examiner immediately if a candidate is familiar with his subject.

The Board of Examiners regrets to note that in many of the answers, in all grades, candidates either avoided the questions involving calculations or answered these incorrectly. Since mathematics is a fundamental subject which is of vital importance for engineers, more attention should be given to this subject.

The question papers were again thoroughly practical, and should not have been unduly difficult to candidates engaged in the practice of gas manufacture or supply. Once again it may well be asked—do candidates keep note-books to record their work daily, and make sketches of the plant on which they are engaged?

Ordinary Grade Gas Engineering (*Manufacture*).

Number of candidates who sat for the Examination:

Class.	Internal—29. No.	Internal—29. %	External—29. No.	External—29. %	Total—58. No.	Total—58. %
1st ...	2	6.9	2	6.9	4	6.9
2nd ...	14	48.3	12	41.4	26	44.8
Fail ...	13	44.8	15	51.7	28	48.3

The total number and the numbers of both internal and external candidates entering for the Examination are almost the same as last year. The results also are similar, although the total number of failures has increased from 44 to 48%. The standard of the answers, which was generally poor, is well shown by the fact that in only one question was the average mark obtained 60%. In the remaining questions the average mark was about 50%, and some well below. The failure of candidates to complete calculation correctly indicates a weakness in their general standard of education. Many candidates lost marks through not reading the questions properly, or through lack of ability to express themselves clearly, resulting in confused answers.

Higher Grade Gas Engineering (*Manufacture*).

Number of candidates who sat for the Examination:

Class.	Internal—22. No.	Internal—22. %	External—22. No.	External—22. %	Total—44. No.	Total—44. %
1st ...	2	9.1	—	—	2	4.55
2nd ...	10	45.45	11	50	21	47.7
Fail ...	10	45.45	11	50	21	47.7

Twelve more candidates entered for this Examination than last year, ten internal and two external. The general standard was slightly better, 48% failures against 50%, and one of the internal candidates gained a distinction. Otherwise the standard was again poor and disappointing. Candidates should read the questions carefully, answer concisely, and not make rambling statements in attempts to camouflage their ignorance. Very few candidates attempted the question on heat balances, and most of them had little knowledge of the subject. Knowledge of instruments for recording the calorific value of gas was not up to the standard to be expected. Few candidates were able to compare the different instruments in use.

Diploma Grade Gas Engineering (*Manufacture*).

Twelve candidates entered for the Examination. Ten of them took the Home Paper, while one candidate submitted a Thesis. In the written paper the following results were obtained:

1st Class ... ... 2 = 16.6%
2nd Class ... ... 5 = 41.7%
Fail ... ... 5 = 41.7%

The increase in the number of candidates—12 against 4 in 1942—is encouraging under war conditions, but the standard was disappointing, only two candidates obtaining reasonably good marks. Answers were vague, and not up to the standard one expects in a Diploma Examination.

Ordinary Grade Gas Engineering (*Supply*).

Number of candidates who sat for the Examination:

Class.	Internal—7. No.	Internal—7. %	External—11 No.	External—11 %	Total—18. No.	Total—18. %
1st ...	—	—	1	9.1	1	5.5
2nd ...	4	57.2	6	54.5	10	55.6
Fail ...	3	42.8	4	36.4	7	38.9

The number of candidates entering for the Examination was less than last year—18 against 31. The results, however, are extremely disappointing. Only one candidates obtained a first-class pass, and 39% failed as against 26% who failed last year. As the above table shows, the External candidates did better than the Internal candidates.

Higher Grade Gas Engineering (*Supply*).

Number of candidates who sat for the Examination:

Class.	Internal—7. No.	Internal—7. %	External—12. No.	External—12. %	Total—19. No.	Total—19. %
1st ...	1	14.3	—	—	1	5.3
2nd ...	1	15.3	6	50	7	36.8
Fail ...	5	71.4	6	50	11	57.9

The number of candidates who entered for the Examination was practically the same as in 1942, 19 as against 18, but the general standard of the work can only be described as unsatisfactory, since 58% of the candidates failed as against 28% in 1942. Only one candidate really knew his subject and was able to express his answers clearly. The spelling and the composition of the remainder was poor. Of the 19 candidates, only one attempted the question on public lighting, and he knew very little about this important subject. In the Examiner's Report last year it was stated that candidates failed to display fundamental, theoretical and practical knowledge of gas distribution and its ramifications, and it is regretted that the same observations must again be made this year.

Diploma Grade Gas Engineering (*Supply*).

Seven candidates entered for this Examination, six of whom took the Home Paper. In the written paper the following results were obtained:

1st Class ... ... 3 = 42.8%
2nd Class ... ... 2 = 28.6%
Fail ... ... 2 = 28.6%

This was the highest number of candidates who have ever entered for the Diploma in Gas Engineering (Supply). This is not only encouraging in itself, but the results obtained in the written paper were also good, as the table above shows. There was one outstanding answer to the Home Paper, but the remaining answers were poor.

New Water Boiler

To meet an increasing demand for canteen equipment Messrs. Thomas Potterton (Heating Engineers), Ltd., have produced a new pattern water boiler having several interesting features. The following is a brief description of the new appliance, which is designed to give quick boiling with a minimum consumption of gas. Rectangular, it occupies little space, and the narrow rectangular flue is staggered to ensure the whole of its surface being effectively used.

The construction is robust with cast-iron base, burners, air direction plate, &c., all as specially designed for the firm's "Empire" boilers, while accessibility of the interior and flueways should lead to low maintenance cost.

The absence of steam discharge from the top of the boiler should appeal, and the use of the steam from the spout for heating both tea and pot is an advantage. The boiler can be used for the dual purposes of tea making and hot water supply to sinks—a service likely to be appreciated in the smaller canteens, or where it may be necessary to supplement the hot water supply by high temperature water for culinary purposes.

Special attention has been paid to automatic control, with immersion thermostats operating through relay valves. When the control is to maintain boiling temperature and avoid the fast boiling that leads to excessive steaming and waste of gas, the thermostat is placed above the water line and operates from the temperature of the steam space, but a small tap is provided to by-pass the thermostat and give high steaming when required to heat teapots. For water temperature the thermostat is situated in the lower part of the tank, and maintains the desired temperature for culinary purposes, with a small tap to by-pass the thermostat when boiling water is required.

There are five sizes, from 6 to 25 gallons, supplied either with or without insulating jackets, and installations can be built up according to requirements on the unit principle.

Dustless Coal

To assist producers of bituminous coal to reduce dust in handling, Bituminous Coal Research, Inc., has under way an extensive research into the materials now on the American market or that are under development for this purpose. A report (*Iron and Coal Trades Review*) by R. A. Sherman and G. W. Land (Batelle Memorial Institute), Columbus, Ohio, recently issued, is principally concerned with calcium chloride as applied to four types of coal.

Based on tests at one week after treatment, calcium chloride satisfactorily reduces the dustiness of domestic stoker coals from seams having inherent or bed moisture contents of 8% or less. Coals of high inherent moisture content, of the order of 18%, are not effectively treated with calcium chloride because of the rapid absorption of the treating material into the coal. The dustiness of coals treated with calcium chloride increases with time of storage because of absorption of the treating material into the pores of the coal, but even after three months of indoor storage, the dustiness of coals having inherent moisture contents of 8% or less is much lower than of the untreated coals.

GAS PRODUCTS PRICES—STOCKS AND SHARES

The London Market Aug. 16.

All Coal Tar Products are in good demand, and Pitch in the London area remains about 45s.

A new Order entitled The Control of Toluene (No. 3) Order, 1943 (S. R. & O. 1943, No. 976), came into force on July 20, and introduces certain changes in the prices for different grades of Toluene.

Prices of Coal Tar Products are unchanged.

The Provinces Aug. 16.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 11d., pure, 2s. 7½d. (controlled by the Control of Toluene No. 3 Order, 1943, dated July 14, operative from July 20, 1943). Naphtha and Xylole controlled by the Coal Tar Naphtha and Xylole Order, 1943, dated May 31 (S. R. & O., 1943, No. 768), operative from June 1. Carbolic acid, 60's, naphthalene, and anthracene controlled by the Coal Tar Products Prices Order S. R. & O. 2509, dated Dec. 7, 1942, and operative from Jan. 1, 1943. Filtered heavy oil (min. gr. 1,080), 7½d. to 8d. Creosote oil has been generally controlled as to direction and price for some time past. Current value—fuel grades 5d. to 5½d.; timber preservation and other purposes 4⅝d. to 6d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Tar Products in Scotland Aug. 14.

Home requirements are well covered. Refined tar controlled. Value is 4½d. per gallon *ex* Works, naked. Creosote oil: Specification oil, 6½d. to 7d.; low gravity, 7½d. to 7¼d.; neutral oil, 6d. to 6½d.; hydrogenation oil, 5⅞d. per gallon; all *ex* Works in bulk. Refined cresylic acid continues strong at 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha: 6½d. to 7d. per gallon. Solvent naphtha: Basic prices delivered in bulk, 90/180 grade 2s. 8d. per gallon, and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 3d. per gallon. Pyridine: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

Markets opened last week with a firm tone, renewed support being forthcoming for home rail junior stocks. As the week progressed, however, business became quiet and irregular—oil shares providing the outstanding exception.

The volume of business in the gas market was on a slightly reduced scale, but prices remained firm and a few stocks showed improvement. Gas Light units, which continued in good demand, were marked *ex div.* at 19s. 9d., while a feature was the rise of 6 points in Commercial 3% debenture to 68½, and at this price the yield is still very high at £4 7s. 6d.%. South Metropolitan ordinary also closed 3 points up at 91½.

The following price changes were recorded during the week:

PROVINCIAL EXCHANGES

Blyth Ord. (*x.d.*)	114—116	Aug. 9
Chester Ord. (*x.d.*)	98—102	Aug. 3

OFFICIAL LIST

Brighton, Hove & Worthing Cons.	87—92	+2
Commercial Ord.	69—74	+2
Ditto 3 p.c. Deb.	66—71	+6
Gas Light Units (*x.d.*)	19/3—20/3	Aug. 9
Ditto 3½ p.c. max. (*x.d.*)	77—82	"
Ditto 4 p.c. Pref. (*x.d.*)	93—96	"
Ditto 3¾ p.c. Red. Pref.	95—98	+1
South Metropolitan Ord.	90—93	+3
Southampton Ord.	92—97	+2
United Kingdom Ord.	20/6—21/6	+-/3d.
Watford Ord. (*x.d.*)...	110—115	Aug. 9

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